

Design of public procurement auctions: Evidence from cleaning contracts

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Abstract

We compare beauty contests with first-price sealed-bid and scoring auctions, using data on public procurement of cleaning services in Swedish municipalities. The lowest submitted and winning bids are similar in all auction designs despite a higher price sensitivity of procurement bureaucrats in scoring (and first-price) auctions. There is more entry in beauty contests, by firms favored in them. Reduced entry into the scoring and price only auctions largely explains why the procurement costs are not lowered compared to beauty contests.

KEYWORDS: public procurement, auction design, entry, beauty contests, scoring

JEL codes: H57, D44, P16

[°] Ari Hyytinen, School of Business and Economics, University of Jyväskylä, P.O. Box 35, 40014 University of Jyväskylä, Finland. Email: ari.hyytinen@jyu.fi. Sofia Lundberg: Department of Economics, Umeå University, 901 87 Umeå, Sweden. Email: sofia.lundberg@econ.umu.se. Otto Toivanen: Katholieke Universiteit Leuven, Naamsestraat 69 3000 Leuven, Belgium. Email: Otto.Toivanen@kuleuven.be. This paper supersedes the earlier procurement analyses of ours that circulated under various titles, such as “Favoritism in public procurement: Evidence from Sweden” and “Politics and procurement: Evidence from cleaning contracts”. Those earlier versions had a different focus and used part of the same contract data that we use in this paper. We would like to thank a number of colleagues and seminar participants for useful comments on those earlier versions, and Rob Porter for discussions on the current one. The usual caveat applies.

1 Introduction

Public procurement constitutes a large and increasing part of economic activity both in developed and developing economies. According to the OECD, public procurement has amounted to about 15%-16% of GDP among its member countries in the recent past. The EU Commission has estimated that each year, different levels of government spend about 20% of EU's GDP to procure goods, works and services (European Commission 2012). Unfortunately for the tax payers, there are relatively few *comparative* empirical analyses of how different types of auction designs, such as first price sealed bid auctions, scoring auctions, average bid auctions, or beauty contests, perform when the public sector purchases a certain basic product or service. Among the most notable exceptions are the analyses by Marion (2007) and Lewis and Bajari (2011) on US highway and roadwork contracts, by Athey, Levin and Seira (2011) on US timber auctions, and by Decarolis (2013, 2014) and Decarolis and Branzoli (2014) on Italian road construction and maintenance contracts.¹ We contribute to this literature by comparing the behavior of the procurement agents and the entry and bidding decisions of firms in a setting where the procured product is simple and where not just two, but three different auction formats have been used.

Our data come from Sweden and refer to public procurement auctions of a clearly defined low-tech product, internal cleaning service contracts. Fundamental for our study is that the contracts for these services have been auctioned by Swedish municipalities using first price sealed bid ('price only') auctions, scoring auctions,

¹ In a seminal study, (List and Lucking-Reiley 2000) use sports-card experiments to compare outcomes between Vickrey sealed-bid auctions and uniform-price auctions. See also (Bhattacharya, Roberts and Sweeting 2014), who analyze how the pre-auction allocation of entry-rights works compared to unregulated entry in the context of first-price auctions, and (Roberts and Sweeting 2013), who compares the performance of auctions with simultaneous and sequential entry.

and beauty contests. The reason for the observed variety in auction design is that our data come from two regimes that differ in how the law regulated procurement activity.² During the first regime, the less stringent procurement law of the 1990s was in place. At the time, the Swedish procurement law allowed the municipalities exceptionally high degrees of freedom in choosing how to procure the services and, in particular, in how to pick the winner. The municipalities ended up using beauty contest auctions. In such an auction, the auctioneer does not commit to an award (allocation) rule and yet ex post pays, if she so wishes, attention to non-price criteria when choosing the winner (Klemperer 2002, Yoganarasimhan 2013). During the second regime, the much stricter procurement law of 2008 was in place. In this regime, the Swedish municipalities had to commit either to a first price sealed bid auction or to a scoring auction, with an explicit award rule and weights, when it procured the services.³

The cleaning contracts procured by Swedish municipalities provide a good testing ground for us for two further reasons. First, cleaning services have a very simple production process that should make them amenable to being procured. The service is simple to contract on and, as we will argue, does not differ much in quality ex ante. Due to this relative homogeneity of the product, there should be relatively few reasons to depart from the policy of granting the contract to the lowest bidder (for a similar argument, but in a different context, see Di Tella and Schargrodsky

² Sweden applied the EU procurement law already in the early 1990s and also subsequently. The Swedish rules were relatively lax in the 1990s, because the European rules of that time allowed high degrees of freedom in organizing procurements. Our research question is thus of interest for all countries applying the EU directives and for all developed countries considering how to improve the design of public procurement auctions.

³ In a scoring auction, the procurement bureaucrat announces and commits to an explicit award rule that balances the non-price (quality) attributes and price (Che 1993, Asker and Cantillon 2008, 2010).

2003, Bandiera, Prat and Valletti 2009).⁴ And yet, we can observe how the Swedish municipalities used beauty contests and scoring auctions, in addition to the standard price only auctions, to acquire these services, and how the firms responded. Second, an important aspect of the institutional environment that we study is that the public procurement auctions in our data happen in a relatively homogenous environment. In each municipality, the principals are the inhabitants of the municipalities and the agents the municipal council or more concretely, the procurement bureaucrats working under the council's management.

Our main results are as follows: *First*, we find that in the old regime, conditional on procuring, the municipalities resorted systematically to beauty contests, as *no* municipality committed to an explicit award rule.⁵ In contrast, one third of the auctions in the new regime are price only, and the rest are scoring auctions. *Second*, the raw data show that in the beauty contests, the lowest bidder did *not* win 58% of the time, and conditional on not choosing the lowest bidder, the municipalities end up paying on average 43% more than the lowest bid. In the scoring auctions, the corresponding percentages are lower, 35% and 20%.⁶ *Third*, consistent with the raw data, our estimates from a discrete choice model suggest that the price sensitivity of the municipal procurement bureaucrats is about twice as large in the scoring auctions as in the beauty contests.⁷ *Fourth*, there is less actual entry to the scoring and price only auctions than in the beauty contests. Importantly, the nature of entry also changed. The new regime led to decreased participation and winning

⁴ Bajari, McMillan and Tadelis (2009) compare auctions and negotiations in procurement and stress tradeoffs between hard-to-observe quality and price when objects are complex and contractual design incomplete. In our case, exactly the opposite holds: Objects are simple and contractual design complete, at least when compared to the procurement of aircrafts and the like. See also Tadelis (2012) and Cameron (2000).

⁵ For example, no municipality chose to have a scoring rule that would have provided content to what the criterion of "best economic value" means.

⁶ In the price only auctions, they are obviously zero.

⁷ The price sensitivity of the auctioneer is, by design, infinite in the price only auctions, conditional on the reservation price not binding.

probabilities by the municipalities' own inhouse-units. Conditional on price, these units were more likely to be chosen in the beauty contests. *Finally*, our instrumental variable (IV) estimations indicate that there is a strong inverse relation between actual (as opposed to potential) entry and minimum and winning bids. Our baseline IV estimates suggest that controlling for potential entry, the entry elasticity of winning bids is about -0.8. This result is robust to allowing for weak and for 'just plausibly' exogenous instruments (Conley, Hansen and Rossi 2012), as well as to a number of alternative model specifications. The entry effect explains why the municipalities ended up paying roughly the same for the cleaning services in all three auction formats, despite them being more price sensitive in the scoring and price only auctions.

We can relate these results of ours to the prior literature from a number of angles. First, our finding that there is less actual entry in the price only and scoring auctions relative to the beauty contests is related to what Decarolis (2013, 2014) has documented for Italian procurements on public works, where first-price auctions replaced average bid auctions.⁸ Lewis and Bajari (2011) build a structural model of scoring auctions and evaluate how they perform relative to first-price auctions in US highway procurements.⁹ We cannot detect any major differences in the

⁸ A related branch in the prior literature deals with abnormally low bids and explains the practice of not allowing such low bids to win. The procurement agent may want to choose some other than the lowest bid, if choosing the bid is associated with a significant risk of cost overruns, see e.g. Lewis (1986), Buccioli, Chillemi and Palazzi (2013), Chang, Cheng and Salmon (2014) or contractor default (Calveras, Ganuza and Hauk 2004, Burguet, Ganuza and Hauk 2012). Concerns of this sort appear to be mostly relevant for larger construction projects and public works. We have found no anecdotes or media coverage that would suggest that cost overruns or contractor defaults are important in the procurement of cleaning services in Swedish municipalities.

⁹ Athey, Levin and Seira (2011) study how entry and bidding patterns differ in timber auctions that used either open or sealed bid procedures. They find that the sealed bid auctions invite smaller bidders and increase the likelihood that they win the auction. Eklöf (2005) uses Swedish data on the procurement of road painting contracts to explore the social costs of not assigning the contract to the most (cost) efficient firm. He also compares how the first-price mechanism compares to a second-price auction. Cameron (2000) compares first price sealed bid auctions with negotiations using US data (see also Bajari, McMillan and Tadelis 2009).

key procurement outcomes, such as actual entry or procurement costs, between the price only and scoring auctions.

Second, our analysis complements Coviello and Mariniello (2014), who emphasize the pros and cons of disclosure requirements.¹⁰ We study beauty contests, which often are said to be opaque and subject to suspicions of favoritism (Klemperer 2002, Tadelis 2012).¹¹ The stricter procurement law disciplined the behavior of the Swedish procurement bureaucrats by forcing them to abandon the practice of using beauty contests. It also increased their price-sensitiveness, conditional on the received bids. However, a (n unintended) consequence of the stricter and more transparent rules seems to be that fewer firms were willing to enter.

Finally, our results suggest that a primary channel through which the adjustment in the different auction designs takes place is the number of bidders. This finding links our analysis to the rapidly growing literature on endogenous participation and selective entry in auctions (e.g. Li and Zheng (2009, 2012), Li and Zhang (2010), Krasnoktskaya and Seim (2011), Athey et. al (2011) Marmer, Shneyerov and Xu (2013), Xu (2013), Roberts and Sweeting (2013), Coviello and Mariniello (2014)). Unlike most of these prior analyzes, we provide insights on the effects of entry restrictions and on the (endogenous) relation between the actual entry and procurement costs. More generally, the link between the control of entry by the procurement bureaucrat, actual entry and procurement outcomes appears to be complex and vary across the different auction formats. These links remain, despite some

¹⁰ The procurement agent may also have preferences over a corporate attribute, such as the size and locality of the firms. In such a case, he may use an explicit bid preference program that awards the contract to the lowest preferred bidder, provided that its bid is close enough to the lowest bid (e.g., McAfee and McMillan (1989), Vagstad (1995)). Marion (2007) analyze US highway procurement auctions and contrasts outcomes in regular first-price auctions with auctions in which an explicit bid preference program for US small businesses was in place. He found that the subsidy program increased the procurement costs a little, possibly due to reduced entry by larger firms. See also Krasnoktskaya and Seim (2011).

¹¹ Yoganarasimhan (2013) provides the first structural analysis of beauty contest auctions, using data on private online freelancing auctions.

important recent contributions, e.g. (Bhattacharya, Roberts and Sweeting 2014), largely unexplored territory.

In the following section, we describe the legal and institutional environment in which the public procurements that we study were organized. Section three is devoted to describing our data. In section four, we present our main results. We offer brief conclusions in section five.

2 Institutional environment

2.1 Public procurement by municipalities

Public procurement by the Swedish municipalities refers to the process through which they acquire goods, works and services from private suppliers. Our procurement data cover two periods, or regimes as we will call them henceforth. The first (old) regime runs from 1990 to 1998 in our data and the second (new) from 2009 to 2010. The municipalities were allowed to freely choose whether to procure or to produce in-house during both regimes. However, conditional on a municipality having decided to procure, its procurement activities are governed by law. Before we describe the relevant laws and how they differed between the two regimes, we briefly explain how the procurements were organized.¹²

In our data, a single procurement is an instance where a municipality purchases internal cleaning services for one or more of its buildings and premises. The bidders are Swedish firms that provide cleaning services. A procurement can consist of one or more sealed-bid auctions, each allocating a single cleaning service contract to the winning bidder. This means that there can for example be a number

¹² We take municipalities' decisions about the number of cleaning service contracts that they procured, as well as their characteristics, as given. It is of course entirely possible that some municipalities decided to procure cleaning services for, say, some of their schools while keeping the cleaning of others in-house. For a study of the behavior and market orientation of the municipalities of a neighboring Scandinavian country (Denmark), see Christoffersen and Paldam (2003).

of buildings and premises for which the firms bid at the same time. However, combinatorial bidding was not applied: During both regimes, the firms have been instructed to submit one bid per contract and the municipalities should accordingly have made decisions “contract-by-contract”.

2.2 Procurement process and legislation

During the first regime that our data cover, public procurement in Sweden was governed by the Public Procurement Act (“Lag 1992:1528 om offentlig upphandling, LOU”).¹³ While the law was not yet in force in 1990-1993, the rules that applied then were essentially the same as under the Public Procurement Act. The law was based on the EU rules that prevailed at the time. During the second regime, public procurement of the type of services we study here was governed by the Public Procurement Act (“Lag 2007:1091 om offentlig upphandling, LOU”). This new national law was effective as of January 1, 2008. It was a direct consequence of the 2004 EU procurement directive, 2004/18/EC.¹⁴

Entry modes and timing of events

Both the old and new laws allowed for four types of entry modes (called Simplified, Open, Restricted, Negotiated). The main difference between these four modes is

¹³ This law followed the COUNCIL DIRECTIVE 92/50/EEC of 18 June 1992 relating to the coordination of procedures for the award of public service contract. We describe some parts of the laws in Appendix 1.

¹⁴ Directive 2004/18/EC of the European Parliament and of the Council of 31 March 2004 on the coordination of procedures for the award of public works contracts, public supply contracts and public service contracts.

that two of them (Simplified, Open) allowed free entry, while the other two (Restricted, Negotiated) did not.¹⁵

The timing of events in the procurement process is roughly as follows: First, conditional on having decided to procure the cleaning of (at least some of) the premises and buildings that a municipality owns and/or rents, the municipal procurement bureaucrats choose the auction format. Then, they choose whether to allow for free entry or not, and conditional on not allowing free entry, which firms to invite.¹⁶ After seeing the call for tenders, the (invited) firms make the participation decision and submit their bids. In the final stage, conditional on seeing which firms participate in the auction and the bids that the firms have submitted, the municipal procurement bureaucrats choose the winner, according to the award criteria to which they have committed (if any; see below).

It is important to point out that in contrast to the first regime, the award of a procurement contract in the second regime followed a two-step procedure after the bids had been submitted: In the first step, bids were screened against mandatory qualification and exclusion criteria. The bids that did not meet these criteria were disqualified.¹⁷ In the second step, qualified bids were evaluated according to the pre-specified award rule. This difference may have affected the entry process; we return to this question in the robustness analysis.

¹⁵ While negotiations were allowed in some of these procedures (see, e.g., chapter 5, “Procurement of services”, in the Public Procurement Act, LOU 1992:1528), they were not used in the procurements that we study.

¹⁶ Conditional on restricting entry, the law allowed the municipalities to quite freely decide how many and which firms to invite.

¹⁷ The content of the calls for tender and the preparation of a bid were more detailed and involved in the new regime than in the old regime. For example, unlike in the old regime, they now include a comprehensive set of mandatory qualification and exclusion criteria and rather detailed instructions of how the bidders are expected to show that they meet these criteria. However, the service in itself, and the technical specifications that describe how e.g. the work is to be done, remained by and large the same.

Supplier selection in the old procurement law

The following features of the old law are central for us: First, conditional on deciding to procure, the law allowed the municipalities to decide whether to allow open entry or not. Second, as a general guiding principle, the lowest bidder should have won. However, there was an exception to this “lowest bid wins” -rule: A municipality had the freedom to deem that some other bid (than the lowest) was “most advantageous economically” when quality, environmental aspects, service and maintenance etc. were also taken into account. Importantly for us, the law did not force municipalities to commit to an award rule or to use any explicit scoring weights. It is also worth pointing out that the law did not mention for example the locality of the bidder as an allowable non-price dimension, but seems not to have ruled it out either.

It is illustrative of the atmosphere of the time that the freedom allowed by the law to deviate from choosing the lowest bid was seen as beneficial. The following quote from a book by a public sector lawyer testifies to this:

“The tender having the lowest price offered should be accepted. If it has been stated in the advertisement that the most economically advantageous tender will be accepted, factors specified therein can be taken into consideration in the assessment of tenders. The factors can be stated according to a degree of priority (LOU 1 ch. 22§), *however this is not a requirement. On the contrary, it can be advantageous to state in the advertisement that such factors are non-prioritized, since this increases the possibility of being able to choose the contractor.*” (Löfving 1994, 65) (Our translation, and italics).

This citation shows how the Swedish procurement law allowed during the first regime the municipalities exceptionally high degrees of freedom in choosing how to procure the services and, in particular, picking the winner by not committing to an award rule. This means that the set of auction formats that was available to the procurement bureaucrats was {Beauty contest, Scoring, Price only}.

Supplier selection in the new procurement law

Article 53 of the new law requires that the call for tender specifies how bids will be evaluated in the second step, after the bids have been screened against mandatory qualification and exclusion criteria in the first step. This means that the terms of the supplier selection method are to be posted in advance. The municipalities can either use the lowest-price-principle, which corresponds to first price sealed bid auction, or the so-called economically most advantageous tender (EMAT) principle, which corresponds to a regular scoring auction. Explicit weighing of different criteria should be the guiding principle when EMAT is applied (for a more detailed account, see e.g. Bergman and Lundberg 2013). This means that in the new regime, the set of auction formats that is relevant for our purposes and that was available to the procurement bureaucrats was {Scoring, Price only}.¹⁸

3 Data

3.1 Data sources

Our bidding and procurement data come from two surveys. The first one was administered to all Swedish municipalities asking them for procurement documents regarding internal cleaning services (Lundberg 2005). The documents are call for tenders or contract notice, technical specification, list of bidders, bids, and the decision protocol stating the winner of the contract. Information about the procurements for the second survey was collected from a procurement database that keeps

¹⁸ To be more specific, the current procurement law also allows the procurement entities to arrange “quality only” auctions, in which the procuring entity sets a price and then potential suppliers compete in quality only; see Bergman and Lundberg (2013). There are no such auctions in our data, but they have been used when other types of services, such as elderly care, have been acquired.

track of calls for tenders in Sweden.¹⁹ Additional information was gathered from the municipalities that according to the procurement database had organized at least one procurement auction.

The first survey is the source of the data for the first of our regimes (1990-1998) and the second survey is the source of the data for the latter regime (2009-2010). In the first survey, the response rate was 79.5 %. The survey responses show that 26% of the municipalities that replied to the survey organized at least one procurement auction in cleaning services during 1990-98. More than 90% of the data of the first survey refers to the latter half of period 1990-1998. The second survey was carried out in 2011. We have supplemented the survey data with municipality characteristics, obtained from Statistics Sweden (SCB).

3.2 Description of the data

Verification of the auction formats

A look at the procurement documents of the old regime reveals that no municipality committed to an award rule. In other words, every municipality grabbed the freedom allowed by the old law. The situation is quite different in the new regime. A perusal of the procurement documents of the new regime shows that all municipalities specified a scoring rule, unless they used the lowest-price principle. The specific design of scoring rules differs over procurements (Bergman and Lundberg 2013), but it was described in detail either in words or in combination with a mathematical expression.²⁰

¹⁹ The data base is maintained by Visma Commerce AB. This is the largest data base in Sweden and it covers approximately 90 percent of all procurements. It didn't exist at the time of the first survey.

²⁰ In a representative case, it gave a 0.35-0.45 weight for the price, and 0.55-0.65 weight for the description of how the cleaning service is to be delivered and for experience.

In sum, all of the auctions of the old regime are (a good proxy for) beauty contests. The two auction formats of the new regime correspond to first-price sealed bid and scoring auctions.

Nature of the procured service and normalization of the bids

In our data, 42% of the premises to be cleaned are schools, 39% are day care centers (and the like), 11% are offices and the rest are other types of premises. A single contract can cover more than one premise. On average, the total size of the premises to be cleaned in a contract is 3800 square meters, but the distribution is skew. The median is 1100 square meters. The average cleaning frequency is 232 days per year and the average contract length is 2.2 years. In a typical (average) procurement, 4 cleaning contracts were auctioned.

The extensive documentation available to us on the technical specifications of the procurements and the specifics of the bids suggest strongly that there is little room for ex ante quality differences in the cleaning services provided, especially after controlling for firm type. That is, it is very hard to see how there could be major discernible quality differences between the bids for a specific premise or building (see also Appendix 2). The most compelling support for this claim is provided by the technical specifications of the procurement instructions. The procurement instructions are in general very detailed. Besides including a detailed description of the premises to be cleaned, the frequency of cleaning, cleaning method, cleaning substances that are preferred and cleaning equipment that is to be employed, they also go into much more minute detail. For example, it is common to state requirements as to the professional education of cleaning staff to be used. Similarly, the monitoring of cleaning is often specified in detail, and it is standard to

require the firm to inform the municipality on several features of the working process, to provide records of hours of work, workforce and machinery employed etc. As if this wasn't enough, in several instances the procurement instructions go into great detail as to how each space (e.g. classroom, toilet) is to be cleaned.

While the above argumentation suggests that it is quite hard to differentiate one-self quality-wise, we do not claim that there are no ex ante quality differences. We argue that the product we study is simpler and more homogenous than the products and contracts that have been considered in the prior comparative work of auction designs. For example, in contrast to the US highway procurements studied by Lewis and Bajari (2011), it is hard to believe that one would obtain significant welfare gains by tilting the award rule in some non-price dimension via a scoring rule.²¹

Our measure of the bids refers to the total price of the cleaning service per square meter (lot size) and day (frequency). This normalization ensures that the raw bids are largely comparable. In our econometric analysis, we also control for the type of the premise and other characteristics of the contracts and allow for scale economies. The bids are expressed in 2013 Swedish krona (1 € \approx 8.96 krona at the end of 2013).

Descriptive statistics

Table 1 gives a set of basic descriptive statistics, conditioning on auction type. Actual entry refers to the number of submitted bids (n) in an auction. Potential entry (N) refers to the total number of firms that submitted at least one bid in a given municipality in our data; for a similar approach, see, e.g. (Li and Zhang 2010,

²¹ Moreover, there seems to be few reasons to expect that cross-firm differences in quality would have changed over time or be significant across the auction formats we consider.

Athey, Levin and Seira 2011, Li och Zheng 2012, Athey, Coey and Levin 2013).²² Free entry is used as the entry mode much more often in the scoring and price only auctions than in the beauty contests. There is less actual entry into them, but roughly the same amount of potential entry. Strikingly, Table 1 also shows that in the beauty contests, the lowest bidder does *not* win 58% of the time, and conditional on not choosing the lowest bidder, the municipalities end up paying on average 43% more than the lowest bid. In the scoring auctions, the corresponding percentages are lower, 35% and 20%.²³ The average winning bids are almost the same in all three auction formats.

[TABLE 1 HERE]

While not shown in the table, there are four main types of firms that participate in the auctions (see also Appendix 3, Table A1). They are large nationally active firms (*National*), in-house units of the municipalities that participate in the auctions as self-standing operative units (*Inhouse*), small local firms (*Local*), which we define as those firms that are not national or inhouse-units and that participate in auctions of only one municipality, and regional firms (*Regional*), which we define as those firms that are not national or inhouse-units and that participate in auctions of more than one municipality.

²² We measure potential entry separately for large and small contracts in each municipality, with the threshold for a large contract being the 80th percentile of the distribution of the (total) size of the premises included in the contract. This means that all auctions in the same size group of a given municipality have the same set of potential bidders.

²³ In the price only auction they are of course zero.

4 Main results

4.1 Behaviour of procurement bureaucrats

Unlike what is typically done in the empirical auction and procurement literature, we start by describing the behavior of procurement bureaucrats.

Discrete choice analysis of the choice of the winner

We study the procurement bureaucrats' choice of the winning bid using a random utility model (McFadden 1974). A standard econometric approach to implement such an analysis is the conditional logit.²⁴ The model uses the bids as the unit of observation and allows us to condition out all additively separable effects that are related to observable and unobservable characteristics of the municipalities (and their procurement bureaucrats), observable and unobservable features of the used auction format, and to observable and unobservable premise and contract characteristics.

Table 2 reports the estimation results from a set of Conditional logit models. The key explanatory variables are *Bid* (in krona per square meter and per day) and its interaction with the auction type indicators, $Bid \times Beauty_contest$ and $Bid \times Scoring$. The more negative the coefficient of *Bid* is, the more weight the price gets in the decision making of the procurement bureaucrats when they choose the winner. Note, in particular, that in the price only auctions, the weight on price is 'infinitely large', because the bids completely determine the choice of the winner. Such auctions are therefore excluded from these estimations. The coefficients of the interaction terms tell us how the price sensitivity of the procurement bureaucrats var-

²⁴ We provide a more detailed explanation of the conditional logit in Appendix 2. See also e.g. Cameron and Trivedi (2005) for a textbook treatment.

ies with the other two auction formats. In Model 1, there are no additional explanatory variables besides the two bid terms. For Model 2, we additionally include the number of bids that each firm submitted in the particular procurement and the total number of bids that each firm submitted during the entire observation period. We use the former variable as a control for the possibility that the municipalities take in the account how active the firms are in the particular procurement event (i.e., the potential multi-unit nature of the procurement).²⁵ We use the latter variable as a crude proxy for the reputation of the firms in the market. In Model 3, we replicate the estimations of Model 1, except that we now add the firm type dummies (*Local*, *Regional*, *National*), interacted with the indicators for the auction types, as controls. Model 4 is a restricted version of Model 3, as we impose the restriction that in the scoring auctions the type of the firm does not matter. Finally, Model 5 includes as controls firm-specific fixed effects, with the exception that all firms that submit less than 20 bids in the data are grouped into a single firm category.

Table 2 yields three main findings. First, the coefficients of the two interaction terms are negative and highly significant. Second, the coefficient of *Bid* \times *Beauty_contest* is clearly smaller (in absolute value) than the coefficient of *Bid* \times *Scoring*. The price sensitivity of the procurement bureaucrats is more than two times greater in the scoring auctions than in the beauty contests. This increase in the price sensitivity is robust across the various specifications that we report in the table. While not shown in the table, the difference in the coefficients is highly significant, with *p*-values being less than 0.05 in each column. The third main finding

²⁵ It is worth pointing out that combinatorial bidding was not allowed and there are no combinatorial bids in the data. This means the winner should have been picked object-by-object. But because in a multi-unit context such a procedure is a source of inflexibility that can lead to an inefficient allocation (see, e.g., Jehiel and Moldovanu (2001, 2003)), the municipalities may have tried to take into account the aggregate outcome, i.e., the fact that in these multi-unit procurements, many firms submitted a bid for more than one object. It is thus possible that they have for example tried to reduce transaction costs. The number of bids per procurement is a control for this.

is that, conditional on the submitted bids, the inhouse-units are more likely than the other types of firms to win in the beauty contests. In the beauty contests, the willingness-to-pay for the cleaning services of the inhouse-units appears to be roughly 0.4-0.5 krona (per square meter and per day) higher than for the services of the other types of firms. This is a substantive amount, when compared to the mean of the winning bids (0.64, see Table 1). The same is not true for the scoring auctions: The firm type indicators are jointly insignificant and their coefficients small in absolute value in the scoring auctions (cf. Model 4).

[TABLE 2 HERE]

Use of free entry

The raw data suggest that the procurement bureaucrats use free entry more often in the scoring and price only auctions than in the beauty contests. To explore this further, Table 3 reports a set of descriptive Linear Probability (OLS) Models. The dependent variable is a binary indicator for the use of free entry in an auction and the standard errors are clustered at the level of procurements.

[TABLE 3 HERE]

In the first model, the only explanatory variables are the binary indicators for the scoring and price only auctions, with the beauty contests being the omitted category. The estimates from this model show that, compared to the beauty contests, the scoring and price only auctions are associated with more frequent use of free

entry. The second model includes, in addition to the auction format -indicators, municipality fixed effects.²⁶ This model confirms the findings of the first model.

For the third model, we add a number of further control variables. They come in two groups. The first group of control variables refers to the characteristics of auction and the service contract that is being auctioned. The variables include type of the premise (four categories: *School*, *Office*, *Day-care center*, *Other*), the length (in years) of the contract (*Contract_length*), the number of years over which the contract can optionally be extended if the municipality so decides (*Extension*), the (scaled) number of days during which the cleaning takes place (*Frequency*) and its square, and the (scaled) size of the premises covered by the contract (*Size_of_premises*) and its square. The second group of control variables consists of municipal unemployment rate (*Unemployment*), population density (*Population_density*, in thousands of inhabitants per the geographical size of the municipality), share of inhabitants having a higher education (*Education*) and a binary indicator that obtains a value of one for those municipalities where leftwing parties have more than 50 percent of the seats in the municipal council (*Red_majority*).²⁷ We also include the (natural) logarithm of potential entry as a control ($\ln(N)$), as well as a piecewise linear trend to account for e.g. technological development within the two regimes (*Trend*) that our data cover.

The estimates of the third model show that the binary indicators for the formats of the scoring and price only auctions obtain positive coefficients and that only the former is significant at the conventional significance levels. The two indicators

²⁶ We group all those municipalities that organize less than five auctions in our data and introduce one group-specific fixed effect for them.

²⁷ While not perfect, this is a parsimonious way to capture the main division in Swedish politics. E.g. Aronsson, Lundberg and Wikström (2000, 192) write: “These two variables [based on council decomposition into leftwing (socialist) and rightwing (non-socialist)] are assumed to control for the widespread belief that socialists and non-socialists usually have different views about public spending and that a fragmented parliament might find it hard to hold back public spending.”

are nevertheless jointly significant, and the latter significant at 10% level. Moreover, we cannot reject the null hypothesis that they are equal. Therefore, in the fourth model, we impose the coefficients of the two binary indicators to be equal. Now we obtain again a positive and statistically highly significant coefficient, indicating that the scoring and price only auctions are associated with more frequent use of free entry than the beauty contests.

4.2 Behavior of firms

Following the prior literature (Lewis and Bajari 2011, Athey, Levin and Seira 2011, Athey, Coey and Levin 2013, Decarolis 2013, 2014), we explore the relation between the auction outcomes and formats by regressing entry and bids on the binary indicators that capture the format of the auctions. We adopt this reduced form approach, because building and estimating a structural model for each auction format would be beyond the scope of this study: As far as we are aware, the literature on the structural estimation of scoring auctions and beauty contests is scant, with the recent work by (Lewis and Bajari 2011) and (Yoganarasimhan 2013) representing the first important contributions.

Entry

In Table 4, we report two count-regressions (Poisson-models) and two OLS-regressions. In the count models, the dependent variable is the number of submitted bids (n), whereas in the OLS-regressions, it is the logarithm of the number of submitted bids ($\ln(n)$).²⁸ In each specification, we include the binary indicators for *Scoring*,

²⁸ We use cluster the standard errors at the procurement level. This means that the estimations are robust to a misspecification in the Poisson model's variance.

Price only, *Free entry* and the interactions of *Scoring* and *Price only* with *Free entry*. *Scoring* and *Price only* measure how much more (or less) there was entry in scoring and price only auctions when entry was not free, relative to similar beauty contests. The coefficient of *Free entry* measures whether free entry was associated with more entry in the beauty contests. The two interaction terms capture how the scoring and price only auctions differ from the beauty contests in this regard. Moreover, we include the logarithm of the number of potential entrants ($\ln(N)$), as well as the set of (other) controls, $X \equiv (\textit{School}, \textit{Office}, \textit{Day-care center}, \textit{Contract_length}, \textit{Extension}, \textit{Frequency}, \textit{Frequency}^2, \textit{Size_of_premises}, \textit{Size_of_premises}^2, \textit{Unemployment}, \textit{Population_density}, \textit{Education}, \textit{Red_majority}, \textit{Trend})$, and municipal fixed effects. The difference between the first and second (third and fourth) columns is that the coefficients of the interactions of *Scoring* and *Price* with *Free entry* are imposed to be equal as they turned out not to be different. A further reason to impose this restriction is that in the clear majority of the scoring and price only auctions entry was free; see the robustness analysis for additional discussion.

The specifications reported in Table 4 correspond closely to the reduced form of Li and Zheng (2009) that they use to explore the relation between entry probability and potential entry in their highway mowing auction data. The implied conditional mean of the number of actual entrants (bidders) is $E(n|W, N) = N^\rho \exp(W' \gamma)$, where W is a vector that includes the auction format indicators and their interactions, vector of other controls X , as well as the municipality fixed effects. As Li and Zheng (2009) mention, the coefficient of N (ρ)

measures whether the entry probability decreases as the potential number of entrants increases.²⁹ As the table shows, our estimate of ρ is 0.3-0.4 and highly significant. Consistent with this, Li and Zheng (2009) report an estimate of 0.4. This result means that as the number of potential entrants increases, the *probability* of entry decreases. At the same time, the estimate means that the expected number of actual entrants increases with the number of potential entrants.³⁰

[TABLE 4 HERE]

Table 4 also shows that the coefficient of *Free entry* is positive and significant. This finding indicates that the use of free entry is associated with a larger number of submitted bids in the beauty contests. However, we find that the opposite is true in the scoring and price only auctions: The coefficients of the interaction terms between the free entry and auction format dummies are negative and jointly significant. Because $E(n|W, N) = N^{\rho} \exp(W' \gamma)$ implies $E(\frac{n}{N}|W, N) = N^{\rho-1} \exp(W' \gamma)$, these findings mean that holding other things constant, the entry probability is lower when free entry is allowed in the scoring and price only auctions than when it is allowed in the beauty contests.

Average and minimum level of bids

We next explore how the average level of bids as well as the minimum level of bids vary between the three auction formats and with the number of bidders. To this end,

²⁹ Proxied by the ratio of actual (n) to potential entry (i.e., n/N)

³⁰ If potential entry, N , increases by one firm, the actual participation ($n = Nq$) may increase, even if entry probability, q , decreases (as our estimates suggest). That is, $\partial n / \partial N = \partial Nq / \partial N = (q + (\partial q / \partial N)N) = q(1 + \varepsilon)$ can be positive, even if the elasticity of entry probability w.r.t. potential entry, denoted ε here, is negative. Actual entry increases with potential entry, unless the response, ε , is very elastic.

we regress the logarithm of the bids (using all the bid data we have) and the logarithm of the lowest bids (using the data on the lowest bids of each auction only) on the indicators of the auction formats, actual entry ($\ln(n)$), potential entry ($\ln(N)$), the vector of other controls (X), and the municipal fixed effects. Following the large and rapidly advancing literature on endogenous participation and selective entry in auctions e.g. (Li and Zheng 2009, 2012, Marmer, Shneyerov och Xu 2013, Gentry och Li 2014), we treat actual entry as endogenous.

To take the endogeneity of the number of actual bidders into account, we use *Free entry* and its interactions with *Scoring* and *Price_only* as the instruments. These variables are valid instruments, if the procurement bureaucrats' decision to use the free entry mode affects bids only through its effect on the probability of entry. Our previous analysis shows (cf. Table 4) that these variables are relevant instruments: Our baseline first-stage specification is identical to the fourth column of Table 4, where the coefficients of interactions $\text{Free_entry} \times \text{Scoring}$ and $\text{Free_entry} \times \text{Price_only}$ are restricted to be equal. We explore the plausibility of our exclusion restrictions and the strength of our instruments in greater detail below.

Table 5 reports the results of the 2SLS estimations when we use the entire bid data and Table 6 the corresponding results when we use the lowest bids only. In both tables, we cluster the standard errors at the level of procurements. The first columns of the two tables report the baseline 2SLS results: In Table 5, the entry elasticity of the average submitted bid is about -0.4 in column 1, but the estimate is significant only at the 10% level. The indicators of the auction formats for the price only and scoring auctions are not significantly different from zero, nor from each other. The coefficient of the potential entry is insignificant, too. In Table 6, the baseline results show that the entry elasticity of the minimum submitted bid is about

-0.6, and the estimate is significant at better than the 1% level. Again, the indicators of the auction formats are not significantly different from zero, nor from each other.

[TABLE 5 AND 6 HERE]

The remaining columns of Table 5 and 6 explore the robustness of our baseline findings. In the second column, we add firm type dummies in the regressions, understanding that they may be endogenous. In the third column we check if the effect of entry on bids is different in the scoring and price only auctions, compared to the beauty contests.³¹ Finally, in fourth and fifth columns, we explore the robustness of our findings to excluding the (insignificant) auction format indicators from the second stage: In column 4, we drop them altogether from the analysis, whereas in column 5, we use them as additional instruments. As both tables show, our baseline finding of there being a negative effect of actual entry on the bids is robust to these modeling changes. The coefficient of the potential entry is never significant.

4.3 Procurement costs and level of winning bids

We now turn to the analysis of procurement costs, which is an outcome of both the (optimal) award behavior of the procurement bureaucrats and the (equilibrium) entry and bidding behavior of firms. To this end, we report in Table 7 a set of 2SLS regressions in which the dependent variable is the logarithm of the winning bid of each auction. The specifications reported in the different columns correspond to those used in Table 6, including the choice of the instruments.³² This set of results

³¹ After first trying separate interactions of the scoring and price only auctions with the number of submitted bids, and finding them not to be statistically different (nor jointly significant), we imposed the same coefficient for the two interactions.

³² We again cluster the standard errors at the procurement level.

allows us to explore how much the municipalities end up paying for the cleaning services and whether the procurement costs are related to the format of the auction and the number of actual bidders.

[TABLE 7 HERE]

Again, the first column reports the baseline 2SLS results. The most important finding is that the entry elasticity of the winning bid is nearly -0.80 and highly significant. The remaining columns of the table explore the robustness of the baseline findings. They show that the result for the entry elasticity is stable. The coefficient of the indicator for the price only auctions is negative and borderline significant and the coefficient of the potential entry is, counterintuitively, positive and sometimes also significant at the 10% level. However, we would like to point out that the findings on the price only auctions and potential entry are *not* a robust feature (see also below).

All models of Table 7 assume that the conditional mean of the winning bids is $E(\text{Winning_bid} | W, n, N) = n^\alpha N^\beta \exp(W' \lambda)$. Together with our first stage formulation, this specification of the conditional mean implies that the (total) effect of potential entry on the winning bids, $\frac{\partial E(\text{Winning_bid} | W, n, N)}{\partial N}$, can be written as $\left[\frac{\partial(N^\beta)}{\partial N} n + \frac{\partial(n^\alpha)}{\partial N} N \right] \exp(W' \lambda)$. This expression can be seen to roughly consist of the competitive $(\frac{\partial(N^\beta)}{\partial N} n \exp(W' \lambda))$ and entry $(\frac{\partial(n^\alpha)}{\partial N} N \exp(W' \lambda))$ effects that Li and Zheng (2009) analyze using their structural approach. The key difference is that we allow for a direct effect of actual entry (number of submitted bids) on the bids, whereas their comparative statics work through participation probabilities. In our case, the (total) effect can be rewritten as $n^\alpha N^{\beta-1} (\beta + \alpha \rho) \exp(W' \lambda)$, where ρ is the

coefficient of N in the first stage. The sign of this expression is determined by $(\beta + \alpha\rho)$. Of the three terms, we can estimate (α, ρ) quite accurately, and they obtain the expected signs ($\hat{\alpha} \approx -0.8, \hat{\rho} \approx 0.36$).³³

4.4 Robustness analyses

We have probed the robustness of our results on the determinants of the winning bids in a number of ways:

Weak instruments: We start by exploring the possibility that our instruments are weak. To this end, we consider the baseline IV model, reported in the first column of Table 7. We can apply Moreira's (2003) conditional likelihood-ratio test (CLR-test) to this model. The CLR-test allows us to test the null hypothesis that the coefficient of the number of submitted bids is zero in the second stage, without assuming that the instruments are strong. The test rejects the null hypothesis firmly ($p\text{-value} < 0.01$). The weak-instrument-robust 95% confidence intervals associated with the statistic is $[-1.59, -0.36]$. Roughly put, this is the set of parameter values for α that are consistent with the data when we allow the instruments to be weak.³⁴

Exclusion restriction: We can also evaluate the *plausibility* of our exclusion restriction, using the approach developed by Conley et al. (2012). This approach can be applied if one suspects that the exclusion restriction does not hold exactly. In our case, such a suspicion would amount to arguing that the use of free entry in the different auction formats is correlated with the unobservables influencing the winning bid, conditional on the actual and potential entry and the other observables.

³³ Note that if we imposed (the clearly insignificant) coefficient of potential entry (β) to be zero, the number of potential entrants would qualify as an instrument for our 2SLS estimations. The theoretical analyses of, e.g., Li and Zheng (2009, 2012) suggest that such an exclusion restriction would not, in general, be appropriate.

³⁴ More formally, the 95% confidence interval refers to those coefficient values for which the rejection probability is below 95%.

To relax the assumption that *Free entry*, *Free entry* \times *Scoring*, and *Free entry* \times *Price_only* are strictly exogenous, we have to take into account that in our baseline 2SLS estimations, the coefficients of *Free entry* \times *Scoring*, and *Free entry* \times *Price_only* were set to be equal in the first stage. While our base results go through even if such a parameter restriction is not imposed, we continue keep it for simplicity here. It means that we have one interaction in the first stage, *Free entry* \times (*Scoring* + *Price_only*), where the expression in the parenthesis is equal to one if the auction format is either scoring or price only. To continue, let γ be a (2×1) vector of parameters that measures whether *Free entry* and the interaction can be excluded from the second stage of 2SLS. If $\gamma = (0, 0)$ exactly, the variables have no direct effect on the winning bids. If, on the other hand, we allow a ‘prior’ distribution for γ , then we can discuss how close the exclusion restriction is to being satisfied. If it is likely that γ is close to zero (and if the probability that it is far away from zero decreases sufficiently rapidly), we can say that the instruments are plausibly exogenous and explore how robust the results are to the small violations of the exclusion restriction.

We have implemented the local-to-zero method of Conley et al. (2012), as follows. First, our prior is that γ is normally distributed. We allow for the followings means of the prior distribution, each in turn: $\{(0, 0), (0.1, 0.1), (-0.1, -0.1), (0, 0.1), (0.1, 0), (0, -0.1), (-0.1, 0)\}$. For example, $(-0.1, 0)$ is roughly equivalent to assuming that the use of free entry in the beauty contests is typically associated with 10% decrease in the level of winning bids beyond its relation with firm participation, whereas the use of free entry would typically have no direct effect on the winning bids in the scoring and price only auctions. The variance of γ is set to $(0.1^2, 0.1^2)$.

Table 8 displays the results for the local-to-zero method. It shows that in each case, the coefficient of the submitted number of bids remains clearly negative. The

coefficients (elasticities) vary in range $[-1.0, -0.6]$ and are mostly significant at better than 5% level, and in two cases at better than 10% level. Based on these local-to-zero estimates, we argue that our results are robust to the suspicion that the use of free entry is correlated with the unobservables influencing the winning bids. We stress that we are not considering minor deviations. Our local-to-zero analysis allows the use of free entry to be associated with 10% increase or decrease in the level of winning bids (on and above the indirect effect via firm entry) in a rather rich fashion across the three auction formats.

[TABLE 8 HERE]

Alternative measure for free entry: In the old regime, all firms knew when making the decision to enter whether or not entry was restricted (as captured by *Free entry*). However, we cannot rule out the possibility that in the new regime, the screening of bids against mandatory qualification and exclusion criteria after the bids had been submitted was used as a form of *delayed* entry restriction, which the firms did or could not anticipate perfectly. Indeed, as Table 1 already showed, the ex post screening of the bids resulted in a number of disqualifications. One could therefore argue that even though free entry was (nominally) used much more often in the new regime, the *effective* entry restrictions did not change as much.³⁵ To explore this, we have considered an alternative indicator of free entry. It equals to *Free entry* but with the twist that in the new regime, it is set to zero (indicating restricted entry), if in a nominally free entry auction, the procurement bureaucrat is

³⁵ We cannot rule out that there also is more red tape in the new regime: Rule-based procurement regulation and more formal procurement processes, characterized by detailed product requirements and bidder qualifications, may make procurement burdensome for potential bidders and increase the entry costs (e.g., Bandiera et al. 2009).

predicted to disqualify one or more bids with a high probability. We do not use the actual disqualifications, because the decision to disqualify one or more bids is made after the bids have been observed by the procurement bureaucrat.³⁶

When we use the alternative indicator of free entry in the place of *Free entry*, and repeat all our main analyses (i.e., the estimations and analyses reported in Tables 4-8), our main findings remain intact. For example, the coefficient of the potential entry ($\ln(N)$) is 0.33 (standard error = 0.088) in the first stage regression (cf. Table 4), which is close to what we reported earlier. The 2SLS estimate of the entry elasticity of the winning bid is -0.79 and highly significant.

A further robustness check is in order: When we use the alternative indicator of free entry in the place of *Free entry*, there is more variation in this measure, conditional on the municipalities using the price only and scoring auctions. We can use this additional variation to explore the restrictiveness of the assumption that the coefficients of *Free entry*×*Scoring*, and *Free entry*×*Price_only* are equal in the first stage. When we replicate the analyses reported in Tables 4-7 using the alternative measure and without the first-stage coefficient restriction, all our results remain unchanged; see Appendix 3 for the details of these results.

Alternative measures of potential entry: In our baseline analyses, we have measured potential entry using the total number of firms that submitted at least one bid in a given municipality in our data, calculated separately for large and small contracts (as measured by the size of the premises). While a similar approach has

³⁶ The procedure to generate the predicted disqualifications is as follows: First, we calculate the number of disqualified bids for each auction. Second, we regress the number of disqualified bids on the auction and municipality characteristics, using data from the new regime only and a count-regression (Poisson). Third, we code a binary indicator for each auction of the new regime so that it takes value one if the predicted probability that at least one bid is disqualified, is greater than 0.50. We set the indicator to zero otherwise. Our results are robust to using a higher threshold for the probability. Fourth, the alternative indicator for free entry is equal to *Free entry*, except for those auctions for which the indicator for the predicted disqualifications is one. These auctions are not considered to have had free entry for the purposes of our alternative free entry measure.

been used in the literature e.g. (Li and Zhang 2010, Li and Zheng 2012 and Athey, Coey and Levin 2013), it is useful to probe the robustness of our basic findings in this regard. First, we can consider alternative thresholds for a large contract. The threshold for a large contract has so far been the 80th percentile of the distribution of the total size of the premises, as calculated separately for each municipality. If we use the median of the municipality-specific distributions, our results on how the three auction formats differ and how the potential and actual entry affects bids, remain intact. In these models, the second stage coefficient of potential entry is however not significant. Second, one might ask whether there is a degree of non-linearity in the relation between potential and realized entry. If we use potential entry linearly (instead of logarithm) and its square, our results remain intact. The linear term obtains a positive and significant and the squared term a negative and significant coefficient in the first stage where the dependent variable is the logarithm of the submitted number of bids. This finding supports the original specification of the potential entry in logarithms and suggests that the entry *probabilities* (as proxied by n/N) decrease with each additional potential entrant, but at a decreasing rate. Our main results are also unchanged if we add a square of the logarithm of the number of potential bidders to the baseline 2SLS model for the winning bids. In these models, the variables capturing potential entry are not significant in the second stage.

Alternative functional forms: We have re-run our baseline analyses using an alternative specification for the conditional mean. In the base line, the conditional mean of the winning bids is $E(\text{Winning_bid} | W, n, N) = n^\alpha N^\beta \exp(W' \lambda)$. If we use $E(\text{Winning_bid} | W, n, N) = \exp(\alpha n + \beta N + W' \lambda)$ instead, our results remain unchanged.

Alternative estimation sample: It turns out that in our data, not all municipalities organize procurements both during the old and new regime. If we restrict our

estimation sample to only those municipalities that organized procurements during both periods, the size of our estimation sample decreases considerably, to 623 auctions.³⁷ However, when we repeat the 2SLS analyses reported in Tables 6 and 7 for the minimum and lowest bids, we find that our results are robust to using this smaller sample. For example, the entry elasticity of the winning bids is -0.7 and, despite the smaller sample, is still significant at better than 10% level.

4.5 Discussion

We use Figure 1 to illustrate the economic significance of our main findings. In the upper part of the figure, the left-hand graph displays the logarithm of the number of submitted bids for each auction format. It shows that there is less actual entry in the price only and scoring auctions. The right-hand graph shows the mean of the logarithm of the winning bids: In the raw data, the average winning bids are almost the same in all three auction formats, despite the procurement bureaucrats being less price sensitive in the beauty contests (as our conditional logit estimates showed). To show the importance of the entry effect for these data patterns, we use the 2SLS estimates from Table 7 (Models 1 and 4) to predict the level of winning bids in the scoring and price only auctions, had the entry remained at the observed level of the beauty contests. The results are displayed in the lower part of the figure: In the left-hand graph, we allow the auction formats to have a direct effect on the

³⁷ We would like to point out that in this sub-sample, the municipalities organize price only auctions in the new regime less often than in the full sample: In the full sample, the share of price only auctions is about one third. In the sub-sample that organized procurements during both periods in our data, the share is about one fifth. For this sub-sample, we can also check whether those municipalities, which allowed the lowest bidder to win often in the beauty contests of the old regime, were more likely to organize price only auctions in the new regime. They indeed were. Conditional on a municipality letting the lowest bid to win in more than half of the beauty contests, the share of auctions that were price only in the new regime is 0.27. The corresponding share in the municipalities that let the lowest bidder to win in less than half of the beauty contests is 0.13.

winning bids (even though they are not statistically significant at conventional levels; see Model 1 of Table 7). In the right-hand graph, we restrict the direct effects to zero (as we did for Model 4 of Table 7). Both graphs show that the auction format has a clear *indirect* effect on the lowest bids via entry adjustments. Had entry remained at the observed level of the beauty contests in the price only and scoring auctions, the lowest bids would have been clearly lower.

[FIGURE 1 HERE]

Our finding that there is less entry in the price only and scoring auctions than in beauty contests is consistent with what Decarolis (2013) has documented for Italian procurements on public works, where first-price auctions were substituted for average bid auctions: Procurement rules that give a more explicit and prominent role for the price may reduce entry incentives. However, we do not find significant decreases in the winning bids (procurement costs), which is unlike what Decarolis finds in his companion paper (Decarolis 2014). In that paper, Decarolis also shows that the first price auctions resulted in poorer ex post performance.

The structural analysis of Lewis and Bajari (2011) points to strong entry effects of using a scoring auction, relative to what they call ‘standard contracts’ (where there is only a minimum threshold in the non-price dimension). Their analysis also suggests that direct procurement costs are about 7-8% higher in the scoring auctions (which were more than compensated by the social savings from quicker completion of the road works). We find no clear differences in the actual number of bidders or bids between the price only and scoring auctions.

Our findings also complement those of Coviello and Mariniello (2014), who show that greater transparency (publicity requirements) leads to more entry and

lower procurement costs. To the extent that beauty contests are less transparent and more subject to suspicions of favoritism than price only and scoring auctions, our findings suggest that the dimension(s) in which procurement transparency and ‘integrity’ are increased matters a great deal for procurement outcomes. Transparency may come at the cost of reduced entry.

Finally, the prior literature on endogenous participation and selective entry suggests that a primary channel through which the adjustment to the features of different auction designs takes place is the number and type of bidders who actually select to enter e.g. (Li and Zhang 2010, Li and Zheng 2012, Athey, Coey and Levin 2013, Roberts and Sweeting 2013, Coviello and Mariniello 2014). In our data, such a channel appears to be at work, too. We find that entry restrictions imposed by the procurement bureaucrats matter for actual entry and that the precise mechanism may depend on the type of auction format. Our conditional logit estimates showed that inhouse-units were more likely to be chosen in the beauty contests. Moreover, Table A1 (see Appendix 3) reveals that the participation probabilities of inhouse-units are clearly lower in scoring and price only auction than in beauty contests, as is their probability of winning conditional on participation. If the success of the inhouse-units in the beauty contests was based on their superior quality, one would not have expected that their participation and winning probabilities decreased in the new regime. In contrast, our findings would be in line with their winning probabilities in the beauty contests resting on them enjoying some sort of favoritism (e.g., McAfee and McMillan 1989).

Taken together, these results suggest that how to properly regulate bidder participation may be context specific (Bhattacharya, Roberts and Sweeting 2014). For example, it seems natural to think that when there are non-negligible entry costs,

the least efficient firms' incentive to enter is weakened if the decision maker becomes significantly more price-sensitive in an auction that permits non-price award criteria. When the potential participants obtain private signals about their costs prior to making the entry choice (Gentry and Li 2014, Roberts and Sweeting 2013), such a behavioral change may make entry more selective. It may even work as a substitute for the direct regulation of bidder participation.

5 Conclusions

The fight against inappropriate and inefficient practices in public procurement takes many forms. Recommendations for greater integrity, transparency and adoption of rule-based practices are widespread. For example, the US Federal Acquisition Regulations appear to strongly encourage the use of transparent auction mechanisms. Tadelis (2012, p. 301-302) summarizes the motivation of such policy by concluding that “[a]llowing for greater discretion in contractor selection increases the possibility of favoritism, kick-backs and political corruption” and that “[t]he competitive bidding system is less prone to corruption since it allows for free entry by qualified bidders and there is an objective criteria for selecting the winner”; see also Klemperer (2002) for a similar view.

The stricter EC procurement directives and Swedish procurement law disciplined the behavior of procurement bureaucrats in two ways. It induced them to replace beauty contests with more transparent price only and scoring auctions and resulted in a more entry-friendly practices and price-sensitive designs. The stricter procurement law thereby increased the integrity of procurement practices, and led to decreased participation and winning probabilities of the inhouse-units. We do not

find evidence that the procurement costs would have decreased as a result. The reason appears to be that the greater integrity resulted in reduced entry. The appropriate design of entry incentives in procurement auctions cannot be overemphasized.

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Directives and Laws:

COUNCIL DIRECTIVE 92/50/EEC of 18 June 1992 relating to the coordination of procedures for the award of public service contract

Directive 2004/18/EC of the European Parliament and of the Council of 31 March 2004 on the coordination of procedures for the award of public works contracts, public supply contracts and public service contracts.

The Public Procurement Act (LOU 2007:1091).

The Public Procurement Act (LOU 1992:1528)

Tables

Table 1: Descriptive statistics of auctions and bids

Auction characteristics					
	# of auctions	Free entry	# of submitted bids	# of qualified bids	Potential entry
Beauty_contest	720	0.57	7.44	7.44	18.62
Scoring	240	0.96	5.97	5.92	18.70
Price_only	115	0.97	5.50	5.19	18.10
Total / sample	1,075	0.70	6.91	6.86	18.58
Winning vs. minimum bids					
	Minimum bid	Winning bid	Lowest bid wins	Chosen bid gap	Chosen bid gap, > 0
Beauty_contest	0.53	0.64	0.42	0.25	0.43
Scoring	0.63	0.67	0.65	0.07	0.20
Price_only	0.65	0.65	1.00	0.00	-
Total / sample	0.57	0.65	0.53	0.18	0.39
Within-auction statistics					
	Mean rank of win	Mean bid	Median bid	Coeff. of variation	Kurtosis
Beauty_contest	2.59	0.78	0.76	0.26	2.4
Scoring	1.63	0.86	0.83	0.23	2.18
Price_only	1	0.81	0.79	0.17	2.02
Total / sample	2.20	0.8	0.78	0.24	2.32

Table 2: Choice of winner (Conditional logit)

	Model 1	Model 2	Model 3	Model 4	Model 5
Bid*Beauty_contest	-4.058*** (0.278)	-3.934*** (0.278)	-3.948*** (0.285)	-3.948*** (0.285)	-4.681*** (0.351)
Bid*Scoring	-6.905*** (1.054)	-6.664*** (1.058)	-7.142*** (1.069)	-7.015*** (1.056)	-7.884*** (1.302)
Firm-level controls:					
# of bids in the procurement	-	0.198 (0.823)	-	-	-
# of bids in the data	-	0.082*** (0.012)	-	-	-
Firm type -dummies:					
National*Beauty_contest	-	-	-1.443*** (0.111)	-1.443*** (0.111)	-
Regional*Beauty_contest	-	-	-2.016*** (0.134)	-2.016*** (0.134)	-
Local*Beauty_contest	-	-	-2.148*** (0.167)	-2.148*** (0.167)	-
National*Scoring	-	-	-0.311 (1.211)	-	-
Regional*Scoring	-	-	-0.357 (1.208)	-	-
Local*Scoring	-	-	-0.036 (1.227)	-	-
Omitted firm type	-	-	Inhouse	Inhouse	-
Firm FE	No	No	No	No	Yes
Price only -auctions	Excluded	Excluded	Excluded	Excluded	Excluded
Implied coefficient, if could be included:					
Bid*Price_only	-∞	-∞	-∞	-∞	-∞
Observations	6,783	6,783	6,783	6,783	6,783

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3: Choice of allowing for free entry (Linear probability model)

	Model 1	Model 2	Model 3	Model 4
Scoring	0.393*** (0.093)	0.399*** (0.110)	0.362*** (0.119)	0.350*** (0.120)
Price_only	0.400*** (0.093)	0.328*** (0.102)	0.272* (0.151)	0.350*** (0.120)
Controls	No	No	Yes	Yes
Municipal FE	No	Yes	Yes	Yes
Observations	1,075	1,075	1,067	1,067

Cluster-robust standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

In model 4, the coefficients of the auction types were restricted to be the same.

Table 4: Actual entry -regressions

	(Poisson)	(Poisson)	(OLS)	(OLS)
	Number of submitted bids	Number of submitted bids	ln(Number of submitted bids)	ln(Number of submitted bids)
	Model 1	Model 2	Model 3	Model 4
Scoring	-0.025 (0.223)	-0.027 (0.194)	-0.014 (0.266)	-0.012 (0.218)
Price_only	-0.203 (0.269)	-0.197 (0.217)	-0.235 (0.262)	-0.239 (0.238)
Free_entry	0.455*** (0.126)	0.455*** (0.126)	0.473*** (0.113)	0.473*** (0.113)
Free_entry * Scoring	-0.374* (0.218)	-0.372* (0.193)	-0.425* (0.241)	-0.427** (0.206)
Free_entry * Price_only	-0.365 (0.321)	-0.372* (0.193)	-0.432 (0.323)	-0.427** (0.206)
Ln(Potential entry)	0.365*** (0.105)	0.365*** (0.102)	0.329*** (0.090)	0.329*** (0.087)
Municipal FE	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes
Observations	1,067	1,067	1,067	1,067

In model 2 and 4, the coefficient of the interactions were restricted to be the same.

Cluster-robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 5: Log(bid), 2SLS, all bids

	Model 1	Model 2	Model 3	Model 4	Model 5
Ln(Submitted_no_of_bids)	-0.425*	-0.479**	-0.253	-0.409*	-0.363*
	(0.221)	(0.231)	(0.253)	(0.213)	(0.204)
Scoring	-0.014	-0.038	-1.004	-	-
	(0.135)	(0.136)	(0.953)		
Price_only	-0.136	-0.155	-1.032	-	-
	(0.175)	(0.178)	(0.883)		
Ln(Submitted_no_of_bids)*Scoring	-	-	0.567	-	-
			(0.536)		
Ln(Submitted_no_of_bids)*Price_only	-	-	0.567	-	-
			(0.536)		
Ln(Potential entry)	0.168	0.175	0.002	0.164	0.143
	(0.129)	(0.131)	(0.204)	(0.129)	(0.124)
Other controls	Yes	Yes	Yes	Yes	Yes
Municipal FE	Yes	Yes	Yes	Yes	Yes
Firm type dummies	No	Yes	No	No	No
Observations	7,364	7,364	7,364	7,364	7,364

Cluster-robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Instruments

Model 1: {Free_entry, Free_entry*Scoring, Free_entry*Price_only}

Model 2: {Free_entry, Free_entry*Scoring, Free_entry*Price_only}

Model 3: {Free_entry, Free_entry*Scoring, Free_entry*Price_only}

Model 4: {Free_entry, Free_entry*Scoring, Free_entry*Price_only}

Model 5: {Free_entry, Free_entry*Scoring, Free_entry*Price_only, Scoring, Price_only}

In model 3, the coefficient of the interactions were restricted to be the same.

In the 1st stage, the coefficients of Free_entry*Scoring and Free_entry*Price_only were restricted to be the same.

Table 6: Log(minimum bid), 2SLS

	Model 1	Model 2	Model 3	Model 4	Model 5
Ln(Submitted_no_of_bids)	-0.654*** (0.233)	-0.612*** (0.207)	-0.646*** (0.218)	-0.578*** (0.203)	-0.472*** (0.182)
Scoring	-0.034 (0.156)	-0.028 (0.154)	-0.545 (3.026)	-	-
Price_only	-0.251 (0.219)	-0.229 (0.216)	-0.692 (2.620)	-	-
Ln(Submitted_no_of_bids)*Scoring	-	-	0.319 (1.876)	-	-
Ln(Submitted_no_of_bids)*Price_only	-	-	0.319 (1.876)	-	-
Ln(Potential entry)	0.163 (0.126)	0.146 (0.113)	0.098 (0.388)	0.145 (0.122)	0.107 (0.107)
Other controls	Yes	Yes	Yes	Yes	Yes
Municipal FE	Yes	Yes	Yes	Yes	Yes
Firm type dummies	No	Yes	No	No	No
Observations	1,067	1,067	1,067	1,067	1,067

Cluster-robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Instruments

Model 1: {Free_entry, Free_entry*Scoring, Free_entry*Price_only}

Model 2: {Free_entry, Free_entry*Scoring, Free_entry*Price_only}

Model 3: {Free_entry, Free_entry*Scoring, Free_entry*Price_only}

Model 4: {Free_entry, Free_entry*Scoring, Free_entry*Price_only}

Model 5: {Free_entry, Free_entry*Scoring, Free_entry*Price_only, Scoring, Price_only}

In model 3, the coefficient of the interactions were restricted to be the same.

In the 1st stage, the coefficients of Free_entry*Scoring and Free_entry*Price_only were restricted to be the same.

Table 7: Log(winning bid), 2SLS

	Model 1	Model 2	Model 3	Model 4	Model 5
Ln(Submitted_no_of_bids)	-0.814*** (0.255)	-0.741*** (0.219)	-0.815*** (0.262)	-0.656*** (0.217)	-0.512*** (0.193)
Scoring	-0.138 (0.179)	-0.116 (0.169)	-0.114 (4.100)	-	-
Price_only	-0.449* (0.251)	-0.401* (0.237)	-0.429 (3.520)	-	-
Ln(Submitted_no_of_bids)*Scoring	-	-	-0.015 (2.551)	-	-
Ln(Submitted_no_of_bids)*Price_only	-	-	-0.015 (2.551)	-	-
Ln(Potential entry)	0.226 (0.143)	0.210* (0.126)	0.229 (0.525)	0.192 (0.136)	0.140 (0.118)
Other controls	Yes	Yes	Yes	Yes	Yes
Municipal FE	Yes	Yes	Yes	Yes	Yes
Firm type dummies	No	Yes	No	No	No
Observations	1,067	1,067	1,067	1,067	1,067

Cluster-robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Instruments

Model 1: {Free_entry, Free_entry*Scoring, Free_entry*Price_only}

Model 2: {Free_entry, Free_entry*Scoring, Free_entry*Price_only}

Model 3: {Free_entry, Free_entry*Scoring, Free_entry*Price_only}

Model 4: {Free_entry, Free_entry*Scoring, Free_entry*Price_only}

Model 5: {Free_entry, Free_entry*Scoring, Free_entry*Price_only, Scoring, Price_only}

In model 3, the coefficient of the interactions were restricted to be the same.

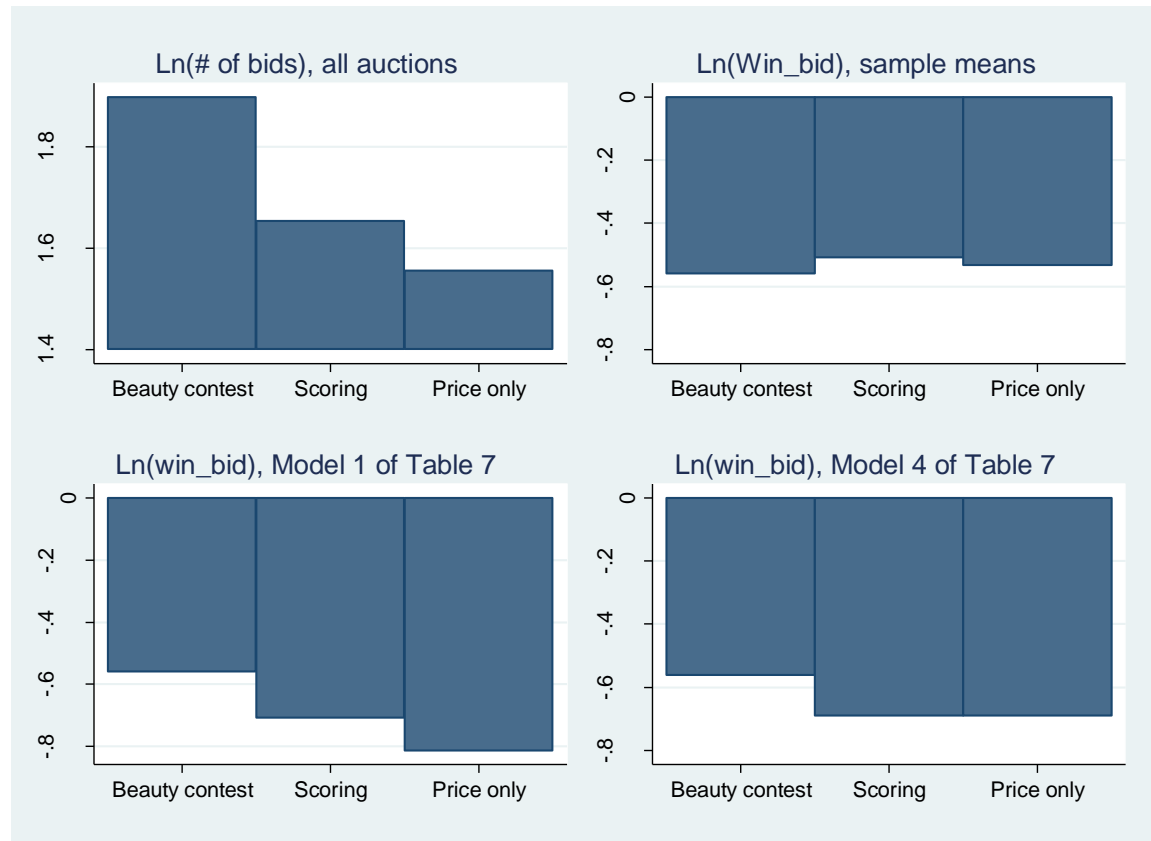
In the 1st stage, the coefficients of Free_entry*Scoring and Free_entry*Price_only were restricted to be the same.

Table 8: Local-to-zero analysis of the plausibility of the exogeneity assumption

Ln(Submitted_no_of_bids)	Mean of γ						
	(0.1, 0.1)	(-0.1, -0.1)	(0.1, 0.0)	(0.0, 0.1)	(-0.1, 0.0)	(0.0, -0.1)	(0.0, 0.0)
Coefficient	-1.046	-0.583	-1.035	-0.825	-0.593	-0.804	-0.814
p-value	0.002	0.084	0.002	0.015	0.079	0.017	0.016

Variance of each term of γ is 0.1^2 .

Figure 1: Comparison of auction formats and counterfactuals



Appendix 1. Regulation of the choice of the supplier

Old regulation – Regime 1

COUNCIL DIRECTIVE 92/50/EEC of 18 June 1992 relating to the coordination of procedures for the award of public service contract: CHAPTER 3 Criteria for the award of contracts Article 36:

1. Without prejudice to national laws, regulations or administrative provisions on the remuneration of certain services, the criteria on which the contracting authority shall base the award of contracts may be:
 - a. where the award is made to the economically most advantageous tender, various criteria relating to the contract: for example, quality, technical merit, aesthetic and functional characteristics, technical assistance and after-sales service, delivery date, delivery period or period of completion, price; or
 - b. the lowest price only.
2. Where the contract is to be awarded to the economically most advantageous tender, the contracting authority shall state in the contract documents or in the tender notice the award criteria which it intends to apply, where possible in descending order of importance.

New regulation – Regime 2

Directive 2004/18/EC of the European Parliament and of the Council of 31 March 2004 on the coordination of procedures for the award of public works contracts, public supply contracts and public service contracts. Section 3, Award of the contract, Article 53, Contract award criteria:

1. Without prejudice to national laws, regulations or administrative provisions concerning the remuneration of certain services, the criteria on which the contracting authorities shall base the award of public contracts shall be either:

- a. when the award is made to the tender most economically advantageous from the point of view of the contracting authority, various criteria linked to the subject-matter of the public contract in question, for example, quality, price, technical merit, aesthetic and functional characteristics, environmental characteristics, running costs, cost-effectiveness, after-sales service and technical assistance, delivery date and delivery period or period of completion, or
- b. the lowest price only.

2. Without prejudice to the provisions of the third subparagraph, in the case referred to in paragraph 1(a) the contracting authority shall specify in the contract notice or in the contract documents or, in the case of a competitive dialogue, in the descriptive document, the relative weighting which it gives to each of the criteria chosen to determine the most economically advantageous tender.

Those weightings can be expressed by providing for a range with an appropriate maximum spread.

Where, in the opinion of the contracting authority, weighting is not possible for demonstrable reasons, the contracting authority shall indicate in the contract notice or contract documents or, in the case of a competitive dialogue, in the descriptive document, the criteria in descending order of importance.

Appendix 2. Details on the discrete choice model

As explained in the main text, we use the random utility model (McFadden 1974) to study the choice of the winning bid. To describe the model, let the municipalities be indexed by m , $m = 1, \dots, M$, premises to be cleaned by i , $i = 1, \dots, I_m$, and bidders (firms) by j , $j = 1, \dots, J_{mi}$. The indirect utility of municipality m from choosing bidder j to clean building i is:

$$U_{mij} = \psi_{mi} + (\eta_1 \times Beauty_contest_{mi} + \eta_2 \times Scoring_{mi}) \times bid_{mij} + \beta' F_j + q_{mij} + \varepsilon_{mij}, \quad (A1)$$

where ψ_{mi} refers to the additively separable effects of municipal/procurement/object characteristics (including the format of the auction), bid_{mij} to the bid (price) of firm j for object i in municipality m (in krona per square meter per day), $Beauty_contest_{mi}$ and $Scoring_{mi}$ to the two auction formats used in auction i of municipality m , F_j to firm attributes, q_{mij} to ‘quality’, and ε_{mij} to an error term.

The municipal/procurement/object characteristics, ψ_{mi} , reflect the mean utility that municipality m obtains when it has its premises cleaned and the object-specific deviations from the mean. It thus captures all additively separable effects of observable and unobservable municipal characteristics on municipal utility, e.g., regional structure, demographics, income distribution, voter preferences, and propensity to procure services. The term also refers to (un)observable object characteristics, such as the type, size, location, etc. of the object. It captures differences in the indirect utility derived, e.g., from having a clean health center as compared to having clean sports facilities. The assumed additive separability of these effects and the distributional (logit) assumption on the error term (see below) allow us to condition all these effects out in the estimation. The term controls in addition for the additively separable effects on the utility of those characteristics of the procurement event that do not vary over the bidding

firms, such as whether or not entry to the auction was open, which auction format was used, and whether or not the object was auctioned as a part of a multi-object procurement.

The second term in (A1) specifies the effect of a submitted bid on the choice, with the coefficient measuring the weight given to the bid. The interaction terms allow us to explore whether the weight attached to price is different between the two auction formats.

The third term in (A1), F_j , allow us to capture the possibility that there are *firm-specific*, as opposed to object-specific, quality differences (i.e., ex ante corporate-level quality differences). For example, a piece of information in the bids in which the firms are able to ‘differentiate themselves’ (besides the price) is the corporate identity of the bidder. This may e.g. convey information about its experience. To capture this, we use firm-type dummies or fixed effects in some specifications. We can also alternatively include the number of bids a firm submits during the entire sample period (to proxy reputation) and the number of bids a firm submits in a given procurement event (to capture elements of “combinatorial bidding”, if any).

The fourth term in (A1), q_{mij} , refers to non-price attributes. It allows for the possibility that municipalities care about the quality of cleaning of *a particular object* for which firms are bidding (i.e., ex ante object-level quality differences). The extensive documentation available to us on the technical specifications of the procurements and the specifics of the bids however suggest that it is likely that there are *no* major ex ante quality differences at the object-level. That is, conditional on the corporate identity of the bidders, it is not likely that there are large, ex ante discernible quality differences *between the bids for a specific object*. As we explained in the main text, the most compelling support for this claim is provided by the technical specifications of the procurement instructions from the old regime: These are in general very detailed, leaving very little room for a firm to differentiate one-self quality-wise, conditional on

F_j .¹ Further supporting evidence comes from interviews that we conducted and especially the type of service we are studying.

The last term in (A1), ε_{mij} , is a stochastic error term that captures intrinsic randomness in municipality decision making. Given ψ_{mi} , the error term only contains bidder-object specific unobservables. It therefore allows for idiosyncrasies in the decision-making of the procurement bureaucrats. We assume that ε_{mij} was unobservable to bidders and distributed i.i.d. type I extreme value.

Given the above assumptions, and imposing the approximation $q_{mij} \approx 0$, the probability that bidder w wins in a procurement auction for object i organized by municipality m is (McFadden 1974):

$$\Pr[y_{mi} = w] = \frac{\exp\{\tilde{U}_{miw}\}}{\sum_{j=1}^{J_{mi}} \exp\{\tilde{U}_{mij}\}} \quad (A2)$$

where

$$\tilde{U}_{miw} = \psi_{mi} + (\eta_1 \times Beauty_contest_{mi} + \eta_2 \times Scoring_{mi}) \times bid_{miw} + \beta' F_w$$

$$\tilde{U}_{mij} = \psi_{mi} + (\eta_1 \times Beauty_contest_{mi} + \eta_2 \times Scoring_{mi}) \times bid_{mij} + \beta' F_j.$$

As specified, the model corresponds to the standard conditional logit model and can be estimated by maximum likelihood (ML).

¹ In addition, the submitted bids that we were able to examine for the old regime reveal that firms almost without exception only detail i) the object for which the firm is bidding, ii) the name and contact information of the bidder, iii) and the price, despite the forms providing space for additional information. If such information is provided, it is invariably uninformative as to potential quality differences. A typical piece of extra information is that the firm j plans to use certain substance S in cleaning, say, school i . The procurement instructions however always dictate in detail the environmental aspects of the substances to be used, and the extra information provided by firm j is that substance S fulfills these criteria. This also suggests that the firms were not able to differentiate themselves quality-wise in the bids.

Appendix 3. Auxiliary tables

Table A1: Frequency of participation and winning, by firm type

Panel A: Participation frequencies, i.e., the fraction of bids submitted					
	# of bids	National	Regional	Local	Inhouse
Beauty_contest	5,359	0.30	0.42	0.20	0.08
Scoring	1,435	0.33	0.50	0.16	0.00
Price_only	633	0.36	0.55	0.08	0.02
Total / sample	7,427	0.31	0.44	0.18	0.06

Panel B: Fraction of auctions won by a given firm type					
	# of auctions	National	Regional	Local	Inhouse
Beauty_contest	720	0.36	0.24	0.09	0.30
Scoring	240	0.44	0.43	0.13	0.00
Price_only	115	0.43	0.54	0.02	0.01
Total / sample	1,075	0.39	0.32	0.09	0.20

Panel C: Winning frequencies, conditional on at least one firm of a given type participating					
	# of auctions	National	Regional	Local	Inhouse
Beauty_contest	720	0.38	0.28	0.13	0.51
Scoring	240	0.44	0.46	0.23	0.14
Price_only	115	0.47	0.59	0.07	0.10
Total / sample	1,075	0.40	0.36	0.15	0.49

Table A2: Entry-regressions
(Alternative measure for free entry)

	(Poisson) Number of submitted bids Model 1	(Poisson) Model 2	(OLS) ln(Number of submitted bids) Model 3	(OLS) Model 4
Scoring	-0.143 (0.197)	0.011 (0.175)	-0.108 (0.212)	0.107 (0.197)
Price_only	-0.086 (0.191)	-0.149 (0.191)	-0.021 (0.221)	-0.120 (0.216)
Free_entry	0.453*** (0.124)	0.459*** (0.126)	0.468*** (0.111)	0.474*** (0.112)
Free_entry * Scoring	-0.249 (0.164)	-0.414*** (0.151)	-0.324* (0.167)	-0.548*** (0.173)
Free_entry * Price_only	-0.524*** (0.188)	-0.414*** (0.151)	-0.693*** (0.217)	-0.548*** (0.173)
ln(Potential entry)	0.359*** (0.103)	0.365*** (0.102)	0.317*** (0.089)	0.328*** (0.088)
Municipal FE	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes
Observations	1,067	1,067	1,067	1,067

In model 2 and 4, the coefficient of the interactions were restricted to be the same.

Cluster-robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table A3: Log(bid), 2SLS, all bids

	Model 1	Model 2	Model 3	Model 4	Model 5
Ln(Submitted_no_of_bids)	-0.403*	-0.455**	-0.276	-0.369*	-0.349*
	(0.212)	(0.221)	(0.212)	(0.204)	(0.198)
Scoring	-0.008	-0.031	-0.903	-	-
	(0.133)	(0.134)	(0.673)		
Price_only	-0.128	-0.146	-0.941	-	-
	(0.171)	(0.174)	(0.634)		
Ln(Submitted_no_of_bids)*Scoring	-	-	0.508	-	-
			(0.366)		
Ln(Submitted_no_of_bids)*Price_only	-	-	0.508	-	-
			(0.366)		
Ln(Potential entry)	0.158	0.165	0.022	0.145	0.136
	(0.126)	(0.128)	(0.159)	(0.125)	(0.122)
Other controls	Yes	Yes	Yes	Yes	Yes
Municipal FE	Yes	Yes	Yes	Yes	Yes
Firm type dummies	No	Yes	No	No	No
Observations	7,364	7,364	7,364	7,364	7,364

Cluster-robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Instruments

Model 1: {Free_entry, Free_entry*Scoring, Free_entry*Price_only}

Model 2: {Free_entry, Free_entry*Scoring, Free_entry*Price_only}

Model 3: {Free_entry, Free_entry*Scoring, Free_entry*Price_only}

Model 4: {Free_entry, Free_entry*Scoring, Free_entry*Price_only}

Model 5: {Free_entry, Free_entry*Scoring, Free_entry*Price_only, Scoring, Price_only}

In model 3, the coefficient of the interactions were restricted to be the same.

Table A4: Log(minimum bid), 2SLS

	Model 1	Model 2	Model 3	Model 4	Model 5
Ln(Submitted_no_of_bids)	-0.599*** (0.216)	-0.561*** (0.196)	-0.645*** (0.211)	-0.442** (0.173)	-0.447*** (0.172)
Scoring	-0.019 (0.152)	-0.014 (0.151)	-0.867 (0.735)	-	-
Price_only	-0.220 (0.211)	-0.200 (0.210)	-0.970 (0.687)	-	-
Ln(Submitted_no_of_bids)*Scoring	-	-	0.519 (0.431)	-	-
Ln(Submitted_no_of_bids)*Price_only	-	-	0.519 (0.431)	-	-
Ln(Potential entry)	0.145 (0.118)	0.129 (0.107)	0.059 (0.112)	0.096 (0.103)	0.098 (0.103)
Other controls	Yes	Yes	Yes	Yes	Yes
Municipal FE	Yes	Yes	Yes	Yes	Yes
Firm type dummies	No	Yes	No	No	No
Observations	1,067	1,067	1,067	1,067	1,067

Cluster-robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Instruments

Model 1: {Free_entry, Free_entry*Scoring, Free_entry*Price_only}

Model 2: {Free_entry, Free_entry*Scoring, Free_entry*Price_only}

Model 3: {Free_entry, Free_entry*Scoring, Free_entry*Price_only}

Model 4: {Free_entry, Free_entry*Scoring, Free_entry*Price_only}

Model 5: {Free_entry, Free_entry*Scoring, Free_entry*Price_only, Scoring, Price_only}

In model 3, the coefficient of the interactions were restricted to be the same.

Table A5: Log(winning bid), 2SLS

	Model 1	Model 2	Model 3	Model 4	Model 5
Ln(Submitted_no_of_bids)	-0.743*** (0.239)	-0.683*** (0.209)	-0.800*** (0.223)	-0.483*** (0.185)	-0.484*** (0.184)
Scoring	-0.119 (0.172)	-0.100 (0.164)	-1.160 (0.777)	-	-
Price_only	-0.410* (0.239)	-0.369 (0.229)	-1.331* (0.730)	-	-
Ln(Submitted_no_of_bids)*Scoring	-	-	0.637 (0.454)	-	-
Ln(Submitted_no_of_bids)*Price_only	-	-	0.637 (0.454)	-	-
Ln(Potential entry)	0.203 (0.135)	0.191 (0.120)	0.098 (0.126)	0.130 (0.115)	0.130 (0.114)
Other controls	Yes	Yes	Yes	Yes	Yes
Municipal FE	Yes	Yes	Yes	Yes	Yes
Firm type dummies	No	Yes	No	No	No
Observations	1,067	1,067	1,067	1,067	1,067

Cluster-robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Instruments

Model 1: {Free_entry, Free_entry*Scoring, Free_entry*Price_only}

Model 2: {Free_entry, Free_entry*Scoring, Free_entry*Price_only}

Model 3: {Free_entry, Free_entry*Scoring, Free_entry*Price_only}

Model 4: {Free_entry, Free_entry*Scoring, Free_entry*Price_only}

Model 5: {Free_entry, Free_entry*Scoring, Free_entry*Price_only, Scoring, Price_only}

In model 3, the coefficient of the interactions were restricted to be the same.

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